NATIONAL CANCER INSTITUTE
Technology Transfer Center

Denoising of Dynamic Magnetic Resonance Spectroscopic Imaging Using Low Rank Approximations in the Kinetic Domain

Summary

Scientists at The National Cancer Institute (NCI) and The National Institute of Neurological Disorders and Stroke (NINDS) have invented a method of imaging glucose metabolism in vivo using MRI chemical shift imaging (CSI) experiments that relies on a simple, but robust and efficient, post-processing procedure by the higher dimensional analog of singular value decomposition, tensor decomposition. This new technology is denoising software for MRIs that significantly improves the measurement of low-intensity signals without the need for dynamic nuclear polarization (DNP). The scientists seek research co-development partners and/or licensees for their invention.

NIH Reference Number

E-063-2017

Product Type

- Software

Keywords

- Denoising, Magnetic Resonance Imaging, MRI, Software Plugin, Dynamic Nuclear Polarization, DNP, Metabolic Enzymes, 13C imaging, Glucose Metabolism, Spectroscopic, Low Metabolite Concentration, Brender

Collaboration Opportunity

This invention is available for licensing and co-development.

Contact

- Thomas Clouse
  NCI TTC

  thomas.clouse@nih.gov (link sends e-mail)

Description of Technology

Accurate measurement of low metabolite concentrations produced by medically important enzymes is commonly obscured by noise during magnetic resonance imaging (MRI). Measuring the turnover rate of low-level metabolites can directly quantify the activity of enzymes of interest, including possible drug targets in cancer and other diseases. Noise can cause the in vivo signal to fall below the limit of detection. A variety

of denoising methods have been proposed to enhance spectroscopic peaks, but still fall short for the detection of low-intensity signals. Dynamic nuclear polarization (DNP) is one method that has been critical for boosting weak signals. DNP must be performed near zero absolute temperature, requiring high operating costs. Measurements are limited to imaging immediately after tracer injection, limiting the range of injectable tracers that can be used in vivo.
To address these issues, scientists at the National Cancer Institute (NCI) and National Institute of Neurological Disorders and Stroke (NINDS) have invented a unique method for measuring low-abundance metabolites in vivo which does not rely on frequency or spatial domains – but instead works in the kinetic domain. Data processing structure is simpler. True weak spectroscopic peaks can be more easily distinguished from noise. This technology improves the signal-to-noise ratio by an order of magnitude or more and has already been tested in vivo. The denoising software enhances low-metabolic signal without the need for DNP, which was previously thought impossible. The method makes MRI more informative for determining the metabolic activity of key enzymes in serious pathologies, is more dynamic in the range of tracers that can be used, and is generally less expensive. This software is also highly adaptable as it can be added as a plug-in to already existing MRI processing software.
The scientists seek co-development parties and/or licensees for their invention.

Potential Commercial Applications

- Plug-in software adaptable for use with current MRI-processing software
- MRIs for clinical or research purposes
- Ancillary invention of X-nuclei leg coil which improves signal-to-noise ratio and is compatible with software

Competitive Advantages

- Unique method for measuring low-abundance metabolites in vivo which does not rely on frequency or spatial domains
- Significant enhancement of raw signal and differentiation when detecting pyruvic acid metabolism to lactate

Inventor(s)

Jeffrey Brender (NCI), Shun Kishimoto (NCI), Murali K Cherukuri (NCI), Hellmut Merkle (NINDS), Jeeva Munasinghe (NINDS), Kazu Yamamoto (NCI), James Mitchell (NCI)

Development Stage

- Prototype

Publications

Brender JR, et al. Dynamic Imaging of Glucose and Lactate Metabolism by 13C-MRS without Hyperpolarization. [Scientific Reports volume 9, Article number: 3410 (2019)]

Kishimoto S, et al. Imaging of glucose metabolism by 13C-MRI distinguishes pancreatic cancer subtypes in mice [PMID 31408004]

Brender J, et al. PET by MRI: Glucose Imaging by 13C-MRS without Dynamic Nuclear Polarization by Noise Suppression through Tensor Decomposition Rank Reduction. [10.1101/265793v1]

Patent Status

- **U.S. Provisional:** U.S. Provisional Patent Application Number 62/459008 , Filed 14 Feb 2017
- **PCT:** PCT Application Number PCT/US2018/018217 , Filed 14 Feb 2018

Therapeutic Area

- Cancer/Neoplasm

Updated

Wednesday, January 25, 2023

Source URL:https://techtransfer.cancer.gov/availabletechnologies/e-063-2017